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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/053,085	11/09/2001	Raymond J. Gorte	PENN.N2437 C	5527

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EXAMINER	
YUAN, DAH WEI D	
ART UNIT	**PAPER NUMBER**
1745	

SHORTENED STATUTORY PERIOD OF RESPONSE	MAIL DATE	DELIVERY MODE
3 MONTHS	02/09/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

If NO period for reply is specified above, the maximum statutory period will apply and will expire 6 MONTHS from the mailing date of this communication.

Office Action Summary	Application No.	Applicant(s)	
	10/053,085	GORTE ET AL.	
	Examiner	Art Unit	
	Dah-Wei D. Yuan	1745	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *19 June 2006*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-30 and 54-61* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-30 and 54-61* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

USE OF SULFUR-CONTAINING FUELS FOR DIRECT OXIDATION FUEL CELLS

Examiner: Yuan S.N. 10/053,085 Art Unit: 1745 February 2, 2007

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on July 26, 2006 has been entered. Claims 1,20,54 were amended. Claims 55-61 were added.

2. The text of those sections of Title 35, U.S.C. code not included in this action can be found in the prior Office Action issued November 2, 2004.

Claim Rejections - 35 USC § 102

3. The claim rejections under 35 U.S.C. 102(b) as anticipated by Mogensen et al. (US 5,350,641) on claims 1,15,18,20,30,54 are withdrawn, because the independent claims 1,20,54 has been amended.

4. Claims 57-61 are rejected under 35 U.S.C. 102(b) as being anticipated by Cable et al. (US 5,589,285).

Cable et al. teach a solid oxide fuel cell comprising an anode, a cathode and a solid oxide electrolyte, wherein the porous anode comprises sulfur tolerant material such as ceria and optionally containing an electronically conducting phase, including Cu. Cable et al. further disclose the level of sulfur content in the hydrocarbon can be as high as 1000 ppm or higher. A process of producing electrical energy is also taught. See Column 2, Lines 49-55, Column 10, Lines 18-30.

Claim Rejections - 35 USC § 103

5. The claim rejections under 35 U.S.C. 103(a) as unpatentable over Mogensen et al. and Annumakonda et al. on claims 2-14,21-29 are withdrawn, because the independent claims 1,20,54 has been amended.

6. The claim rejections under 35 U.S.C. 103(a) as unpatentable over Mogensen et al. on claims 16,17,19 are withdrawn, because the independent claims 1,20,54 has been amended.

7. Claims 1,15-20,30,57,59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wallin (US 6,017,647) in view of Isenberg (US 4,812,329).

With respect to claims 1,20,30,57,59, Wallin teaches a solid oxide fuel cell comprising an electrolyte membrane of a ceramic oxygen ion conductor, a porous anode in contact with the electrolyte membrane on the fuel side of the cell, and a porous cathode in contact the electrolyte membrane on the oxidant side of the cell. The anode is typically a ceramic-metal composite.

The net electrochemical reaction involves charge transfer steps that occur at the interface between the ionically conductive electrolyte membrane, the electronically-conductive electrode and the vapor phase. The vapor phase involves fuel for the anode and oxygen for the cathode. Wallin further teaches the fusion of like particles of the ceramic metal composite anode and the solid electrolyte. The process of producing electrical energy by the solid oxide fuel cell as also taught. See Column 1, Lines 30-42; Example 1.

However, Wallin does not disclose the deposition of ceria in the porous anode structure. Isenberg et al. teach a method of making sulfur tolerant composite cermet electrodes for solid oxide fuel cell, wherein the porous anode is impregnated with solution of cerium nitrate and lanthanum nitrate followed by heat treatment to produce the ceria. The resulting anode has good tolerance to fuel contaminants such as sulfur and other sulfur species. See Column 2, Lines 21-26, Column 6, Lines 12-42. Therefore, it would have been obvious to one of ordinary skill in the art to include ceria deposited in the porous anode structure of Wallin, because Isenberg teaches the resulting coated electrode has better sulfur tolerance. It is also the position of the examiner that the solid oxide fuel cell of Wallin and Isenberg can be used in conjunction with a fuel comprising a sulfur content of from about 1 to about 5000 ppm. This is evidenced by the disclosure in Cable et al. that the impregnation of the anode with cerium oxide can use fuel with sulfur content up to 50 ppm. See Column 2, Lines 29-48.

With respect to claim 15, Wallin discloses the electrolyte membrane is a ceramic oxygen ion conductor. See Column 1, Lines 30-32.

With respect to claims 16-19, Wallin teaches suitable ionically conductive materials include doped zirconia such as yttria-stabilized zirconia, scandium-doped zirconia, gadolinium-doped ceria, and rare earth or alkaline earth-doped $LaAGaO_3$. See Column 4, lines 49-59.

8. Claims 2-14,21-29 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wallin (US 6,017,647), Isenberg (US 4,812,329) and Cable et al. (US 5,589,285) as applied to claims 1,15-20,30,57,59 above, and further in view of Annumakonda et al. (US 6,221,280 B1).

With respect to claims 2-6,9,21-27, Wallin and Isenberg disclose a solid oxide fuel cell as described above in Paragraph 7. However, Wallin and Isenberg do not teach or suggest the use of other sulphur-containing fuels. Anumakonda et al. teach the use of sulfur-containing heavy hydrocarbon fuels for a solid oxide fuel cell. The hydrocarbon fuel is a liquid hydrocarbon having at least six carbon atoms and a sulfur content of at least 50 ppm. In one embodiment, the JP-8 fuel has a sulfur content of about 3000 ppm. The feed, containing the vaporized fuel and oxygen, is partially oxidized by a catalytic reaction to convert the hydrocarbon to hydrogen and carbon monoxide. As a result, the use of catalytic partial oxidation process to produce fuel enables a simplified overall system design. Furthermore, the product gas can be used as a fuel for a fuel cell system, either directly or after treatment for desulfurization. Anumakonda et al. further teach the conversion of refinery liquid hydrocarbon fuels, such as gasoline and naphtha, to hydrogen/carbon monoxide gas streams by partial oxidation process. The hydrocarbon fuels further comprises fuels, such as JP-4 jet fuel, JP-5 jet fuel, JP-8 jet fuel, No. 2 fuel oil, diesel oil, kerosene, and decane. See Abstract, Column 1, Lines 11-15; Column 4, Lines 7-9,35-39,

Column 8, Lines 36-42; Column 11, Lines 58-62. Therefore, it would have been obvious to one of ordinary skill in the art to use a fuel having sulfur content of at least 50 ppm to about 3000 ppm on the solid oxide fuel cell of Wallin and Isenberg, because Anumakonda et al. teach to convert commercially available heavy hydrocarbon fuels to hydrogen, which can be used as fuels for solid oxide fuel cells.

With respect to claims 10-14, Anumakonda et al. teach the military specification for maximum sulfur content in logistic fuels, such as Jet A, JP-4, JP-5, and JP-8, is 0.3 wt% (3000 ppm). Typically, however, commercially available jet fuels have a total sulfur content of about 0.05-0.07 wt.% (500-700 ppm). See Column 2, Lines 38-44. Therefore, it would have been obvious to one of ordinary skill in the art to use a fuel having sulfur content of at about 500 to about 700 ppm on the solid oxide fuel cell of Wallin and Isenberg, because Anumakonda et al. teach the processing and use of a sulfur-containing hydrocarbon fuel, such as JP-4, JP-5, and JP-8, can simplify the overall design of a fuel cell system.

With respect to claims 7,8,28,29, it is well known in the fuel cell art that methane (CH_4) and alcohols, such as methanol and ethanol, are functionally equivalent hydrocarbon fuels. See Patel (US 4,791,033), Column 2, Lines 61-68; Keegan (US 6,423,896 B1), Column 2, Lines 51-65. Therefore, it would have been obvious to one of ordinary skill in the art to substitute methanol for the methane as the fuel in the operation of the solid oxide fuel cell disclosed by Wallin and Isenberg.

9. Claim 54 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wallin (US 6,017,647) in view of Cable et al. (US 5,589,285).

Wallin teaches a solid oxide fuel cell comprising a electrolyte membrane of a ceramic oxygen ion conductor, a porous anode in contact with the electrolyte membrane on the fuel side of the cell, and a porous cathode in contact the electrolyte membrane on the oxidant side of the cell. The anode is typically a ceramic-metal composite. The net electrochemical reaction involves charge transfer steps that occur at the interface between the ionically conductive electrolyte membrane, the electronically-conductive electrode and the vapor phase. The vapor phase involves fuel for the anode and oxygen for the cathode. Wallin further teaches the fusion of like particles of the ceramic metal composite anode and the solid electrolyte. The process of producing electrical energy by the solid oxide fuel cell as also taught. See Column 1, Lines 30-42; Example 1.

However, Wallin does not disclose the deposition of copper in the porous anode structure. Cable et al. teach a solid oxide fuel cell, wherein the porous anode comprises sulfur tolerant material such as ceria and optionally containing an electronically conducting phase, including Cu. See Column 10, Lines 18-30. Therefore, it would have been obvious to one of ordinary skill in the art to include ceria and copper deposited in the porous anode structure of Wallin, because Cable et al. teach the resulting anode has better sulfur tolerance. Cable et al. further disclose the level of sulfur content in the hydrocarbon can be as high as 1000 ppm or higher. See Column 2, Lines 49-55.

10. Claims 55,56,58,60 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wallin (US 6,017,647) and Isenberg (US 4,812,329) as applied to claims 1,15-20,30,57,59 above, and further in view of Cable et al. (5,589,285).

Wallin and Isenberg disclose a solid oxide fuel cell as described above in Paragraph 7. However, Wallin and Isenberg do not teach or suggest the porous anode structure further comprising copper. Cable et al. teach a solid oxide fuel cell comprising an anode, a cathode and a solid oxide electrolyte, wherein the porous anode comprises sulfur tolerant material such as ceria and optionally containing an electronically conducting phase, including Cu. See Column 10, Lines 18-30. Therefore, it would have been obvious to one of ordinary skill in the art to include ceria and copper deposited in the porous anode structure of Wallin and Isenberg, because Cable et al. teach the resulting anode has better sulfur tolerance.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dah-Wei D. Yuan whose telephone number is (571) 272-1295. The examiner can normally be reached on Monday-Friday (8:00-5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick J. Ryan, can be reached on (571) 272-1292. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications

may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Dah-Wei D. Yuan
February 2, 2007

DAH-WEI YUAN
PRIMARY EXAMINER